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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KOJI TAKAHASHI,
YOSHITAKA TOMOMURA,
and HIDENORI KAWANISHI

Appeal 2008-3501
Application 09/936,818
Technology Center 1700

Decided: June 10, 2008

Before EDWARD C. KIMLIN, CHARLES F. WARREN, and KAREN M. HASTINGS, *Administrative Patent Judges*.

KIMLIN, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal from the final rejection of claims 29, 32, 33, and 38-62. Claim 29 is illustrative:

29. A crystal growth method for a III-V compound semiconductor including, as V group components, nitrogen and at least one of arsenic (As), phosphorous (P), and antimony (Sb), the method comprising:

wherein a technique selected from among a molecular beam epitaxial (MBE) growth method, and a gas source molecular beam epitaxial (GS-MBE) growth method is used,

supplying aluminum and ammonium (NH_3) to a surface of the crystal so as to obtain a mixed crystal with a composition comprising nitrogen,

wherein crystallization of the nitrogen from the ammonium which is supplied to the surface of the crystal into the surface of the crystal is accelerated by the aluminum supplied to the surface of the crystal, and

wherein the substrate is at a temperature of 450 degrees C or more and less than 640 degrees C when the aluminum and ammonium are supplied in growing the III-V compound semiconductor that includes, as V group components, nitrogen and at least one of arsenic (As), phosphorous (P), and antimony (Sb).

The Examiner relies upon the following references as evidence of obviousness:

Jiang	5,956,364 B1	Sep. 21, 1999
Tomomura	6,358,822 B1	Mar. 19, 2002
Tomomura (Tomomura '539)[1]	WO 98/44539 A1	Aug. 10, 1998

Ito, "Empirical Interatomic Potentials for Nitride Compound Semiconductors," *37 Jpn. J. Appl. Phys., Part 2, No. 5B*, pp. L574-L576 (1998).

Appellants' claimed invention is directed to a crystal growth method for a III-V compound semiconductor wherein nitrogen is one of the V group elements. The compound also comprises aluminum as a III group element,

[1] The Examiner relies on United States Patent 6,358,822, issued March 19, 2002, to Tomomura (Tomomura '822) as the translation of Tomomura '539 (Ans. 3; see also Final Office Action mailed January 23, 2006 at 2), and thus, we refer to Tomomura '822. Appellants do not dispute the Examiner's reliance on Tomomura '822 in this respect (Br., e.g., 9).

and molecular beam epitaxial (MBE) growth and gas source molecular beam epitaxial (GS-MBE) growth are methods used to form the compound semiconductor. Ammonia is the source of nitrogen and aluminum is supplied to the surface of the crystal and the substrate is at a temperature in the range of 450-640 degrees C.

Appealed claims 29, 32, 33, 38, 39, 42-50, and 53-62 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Jiang in view of Tomomura. Claims 40, 41, 51, and 52 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the stated combination of references further in view of Ito.

Appellants do not set forth a separate substantive argument for the Examiner's § 103 rejection of claims 40, 41, 51, and 52 over the combination of Jiang, Tomomura, and Ito. Also, Appellants present separate arguments only for claims 32 and 33. Accordingly, claims 29, and 38-62 stand or fall together.

We have carefully reviewed each of Appellants' arguments for patentability. However, we are in complete agreement with the Examiner's reasoned analysis and application of the prior art, as well as his cogent and thorough disposition of the arguments raised by Appellants. Accordingly, we will adopt the Examiner's reasoning as our own in sustaining the rejections of record, and we add the following for emphasis only.

There is apparently no dispute that Jiang, like Appellants, discloses a method of making a semiconductor device which employs the technique of molecular beam epitasis (MBE) to make multiple layers of a III-V compound semiconductor, e.g., indium gallium arsenide aluminum nitride (*see* col. 3, ll. 1-40). The Examiner acknowledges that Jiang does not teach

supplying aluminum and ammonium to the surface wherein the substrate temperature is within the claimed range. Tomomura, however, teaches the formation of a Group III-V compound semiconductor layer including nitrogen and aluminum wherein the substrate temperature is maintained at 580 degrees C, a value directly within the claimed range. Tomomura also teaches that ammonia may be used as the source of nitrogen in the MBE method. Consequently, based on the collective teachings of Jiang and Tomomura, we agree with the Examiner that it would have been obvious for one with ordinary skill in the art to use ammonia as the source of nitrogen in the MBE method of Jiang wherein the substrate temperature is within Appellants' recited range. Regarding the claim 32 recitation that the nitrogen composition is controlled based on the ratio of added aluminum, Appellants have not refuted the Examiner's factual finding that "Tomomura teaches optimizing the conditions of each molecular beam to obtain a layer with a desired nitrogen concentration" (Ans. 11, second para., *citing* col. 12, ll. 50-65). We also agree with the Examiner's reasoning with respect to claim 32 that Tomomura's deposition on the substrate clearly suggests that aluminum and nitrogen is crystallized in a restricted region (Ans. 11, last para.).

Appellants contend that "[w]hile Tomomura teaches a substrate temperature of 500-750 degrees C when using NH_3 to form GaInNAs (col. 5, lines 47-57; col. 7, lines 30-41), Tomomura does *not* disclose or suggest using such temperatures when forming a layer with Al therein via MBE-which is a key point of the invention of claim 29" (Br. 13, first sentence). However, we note that the column 5 passage cited by Appellants explicitly discloses that an aluminum-containing layer, AlGaAs, is formed when the

substrate temperature is maintained at 580 degrees C. It is well settled that a prior art value that falls directly within a claimed range anticipates the claimed range. Also, the column 7 passage of Tomomura cited by Appellants states that the substrate temperature was maintained at 580 degrees C when ammonia was used to deposit nitrogen, although a substrate temperature in the range of 500-750 degrees C can be used when ammonia is used as the nitrogen source.

As for Appellants' argument that using temperatures in the claimed range of 450-640 degrees C "during MBE is surprisingly beneficial *when supplying NH_3 and Al at the same time"* (*id. at 2nd sentence*), the Examiner properly points out that the argument is not germane to the claimed subject matter inasmuch as the appealed claims do not require a simultaneous supplying of NH_3 and Al. Moreover, we fully concur with the Examiner that one of ordinary skill in the art would have found it obvious to supply the aluminum and ammonia simultaneously based on the Tomomura disclosure. As explained by the Examiner, "Tomomura teaches forming a mixed crystal of III-V where Ga and In are supplied simultaneously with NH_3" (Ans. 10, second para.; *see* Figure 6 of Tomomura). Since Tomomura discloses the use of Group III elements B, Al, Ga, In, and Tl, we are in full agreement with the Examiner that the reference would have suggested the simultaneous supply of ammonia along with the other Group III elements, including aluminum.

As a final point, we note that Appellants base no argument upon objective evidence of nonobviousness, such as unexpected results, which would serve to rebut the inference of obviousness established by the applied prior art. While Appellants state that "[t]he criticality of this claimed

temperature range has been established" (Br. 12, first para.), Appellants point to no specific objective data which establishes that substrate temperatures within the claimed range produce unexpected results. Manifestly, it is not for the Board to review Appellants' Specification and ferret out data that may support Appellants' assertion of criticality. It is axiomatic that the burden of demonstrating unexpected results that are commensurate in scope with the claimed subject matter rests on the party asserting them. *In re Klosak*, 455 F.2d 1077, 1080 (CCPA 1972). *See also In re Merck & Co*., 800 F.2d 1091, 1099 (Fed. Cir. 1986).

In conclusion, based on the foregoing and the reasons well stated by the Examiner, the Examiner's decision rejecting the appealed claims is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv)(effective Sept. 13, 2004).

AFFIRMED

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